

Predicting Natural Disturbance Patterns in the Pacific Northwest & Species Response



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1st Stage of Project

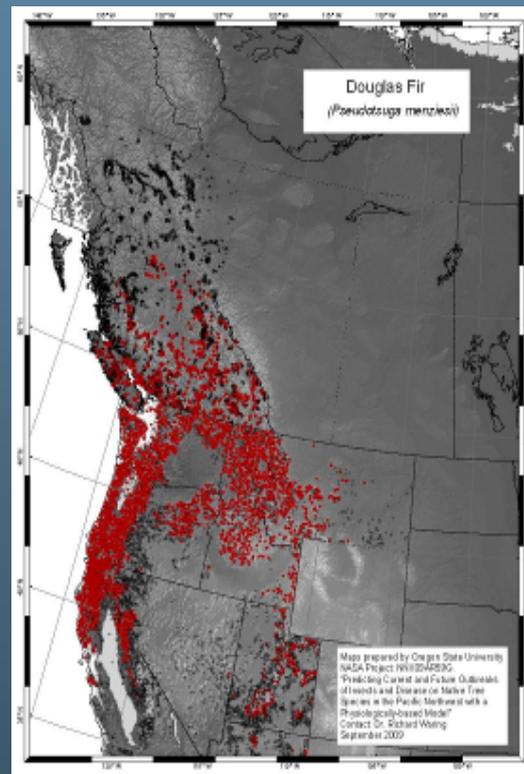
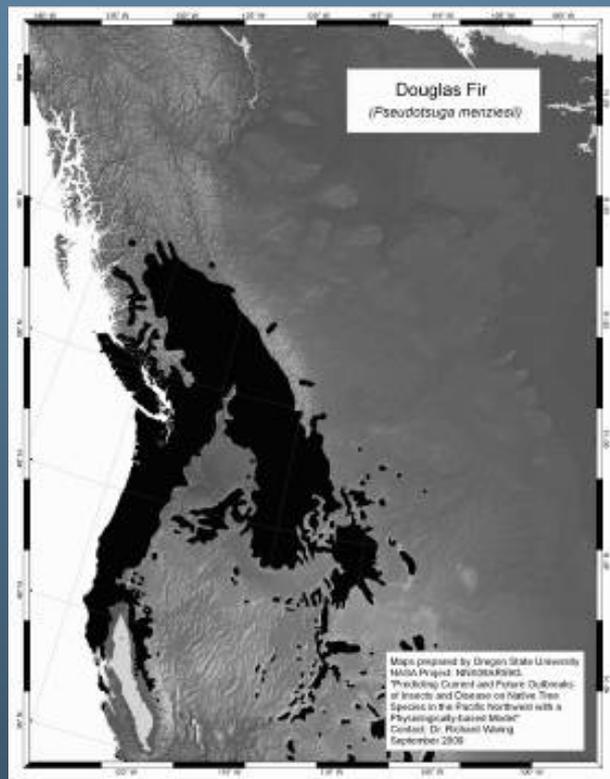
- 1) Show that we can predict current distribution of 20 species with >80% accuracy
- 2) Also, can predict those ecoregions (EPA III) most likely to be heavily disturbed with 70% accuracy

Models developed for the cool, wet 1950-75 period do well predicting the recorded distribution of Douglas-fir on 22,771 permanent field plots

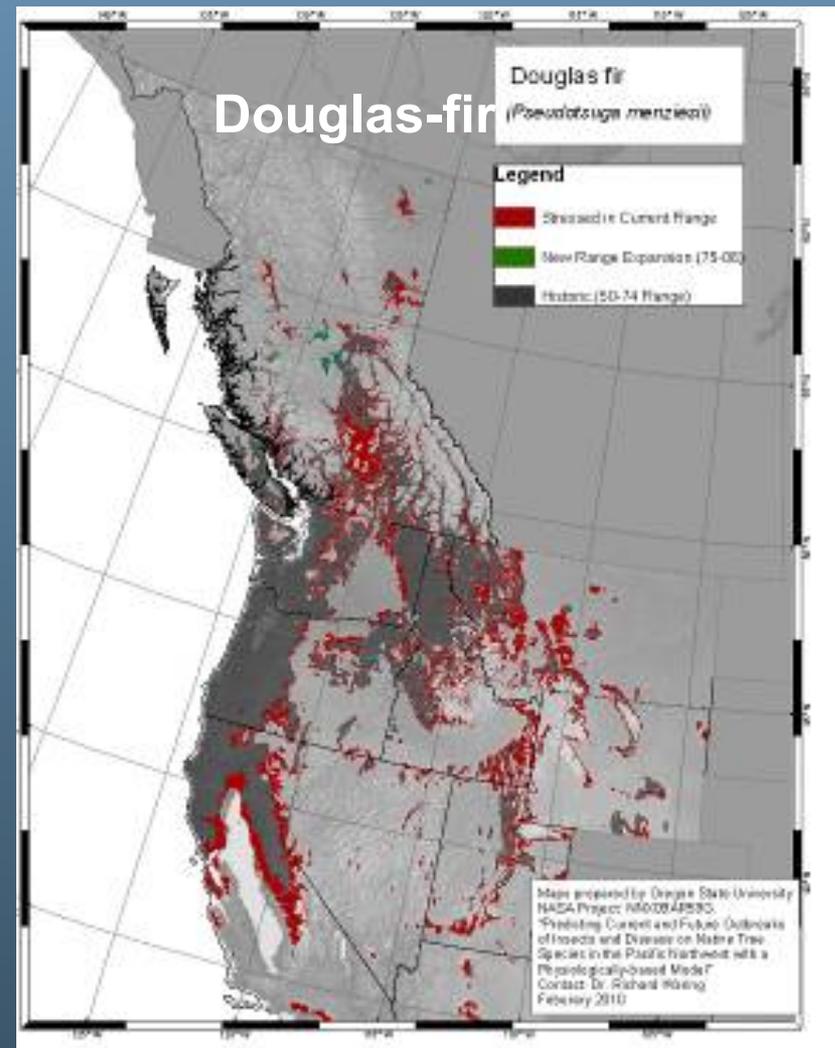
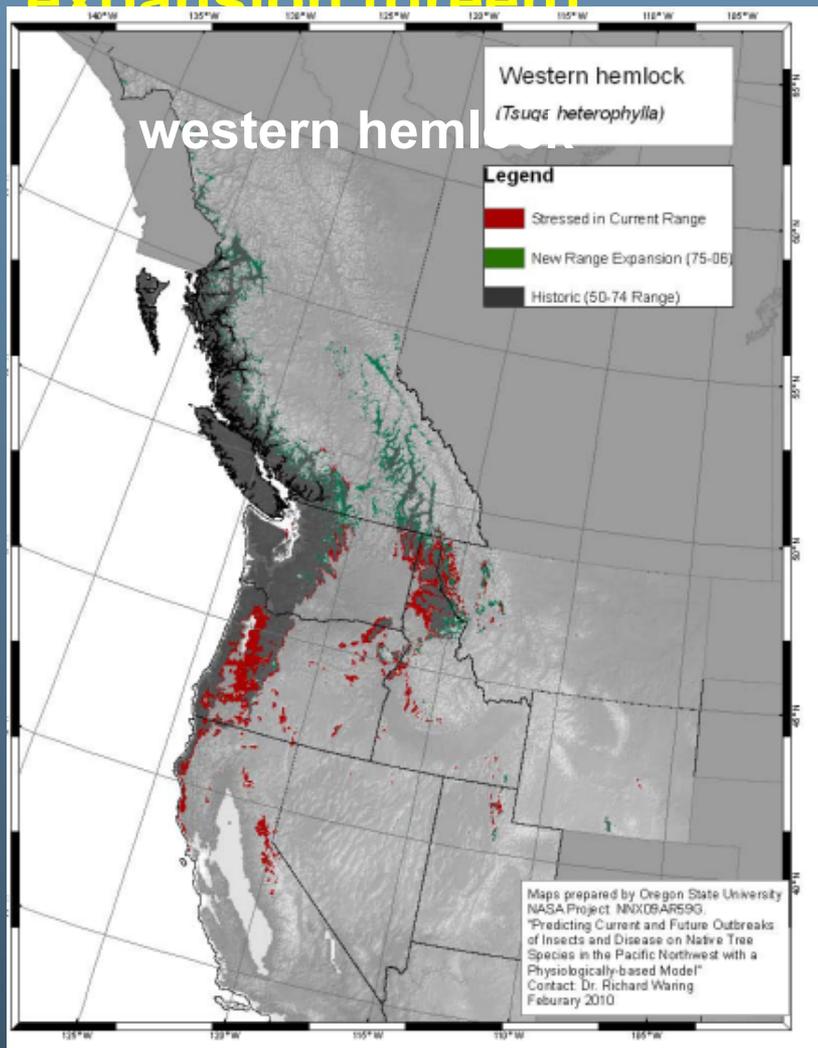
General range map

field records:
present (red),
absent (black)

Predicted range based
on average climatic
conditions

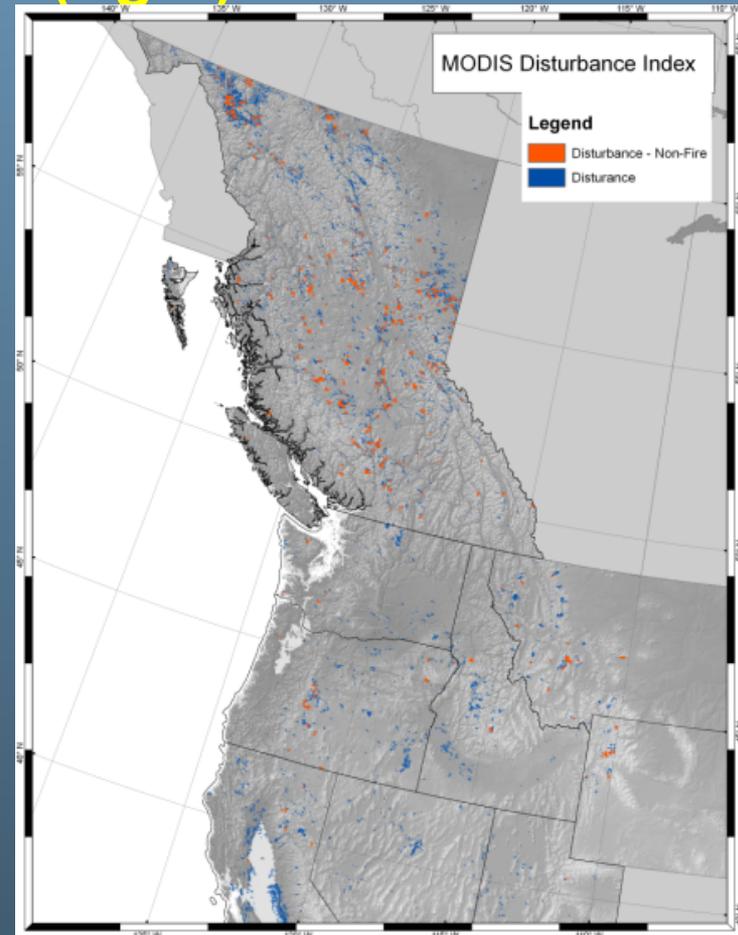
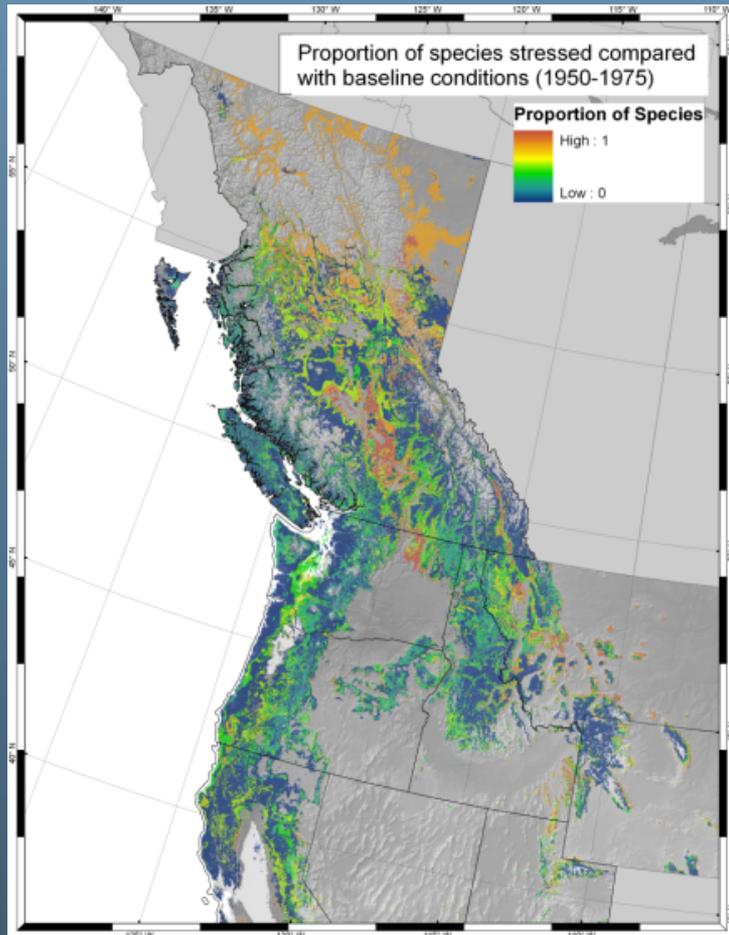


In the last 3 decades, the same models predict that climatic conditions have changed sufficiently to increase the probability of range contraction (red) or expansion (green)



<http://www.pnwspecieschange.info/>

The degree that climatic conditions have changed is reflected in the extent that species are expected to be vulnerable (left) and confirmed from satellite observations of disturbance (right)



Waring, Coops & Running. 2011.
Remote Sensing of Environment
115:3554-3566

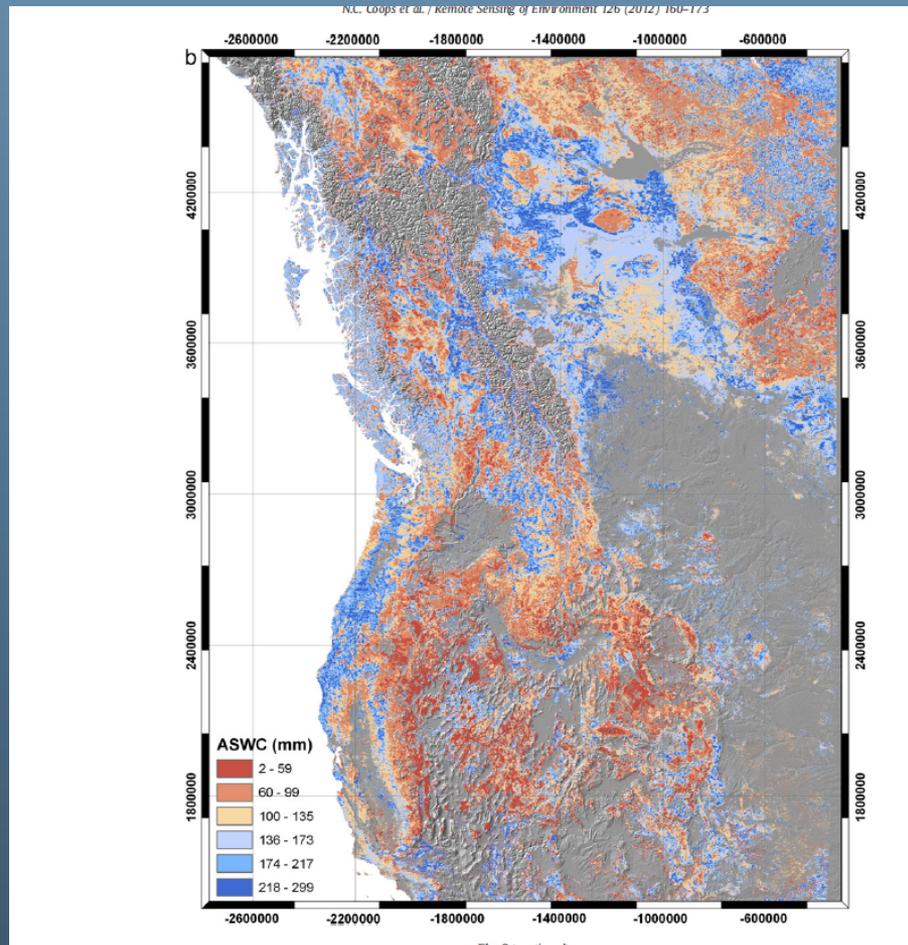
2st stage of Project

- 1) Can we predict the rate of species migration ?
- 2) Can we predict location of fires at 1 km?
- 3) Can we predict outbreaks of bark beetles ?
- 4) Can we predict outbreaks of leaf pathogens?

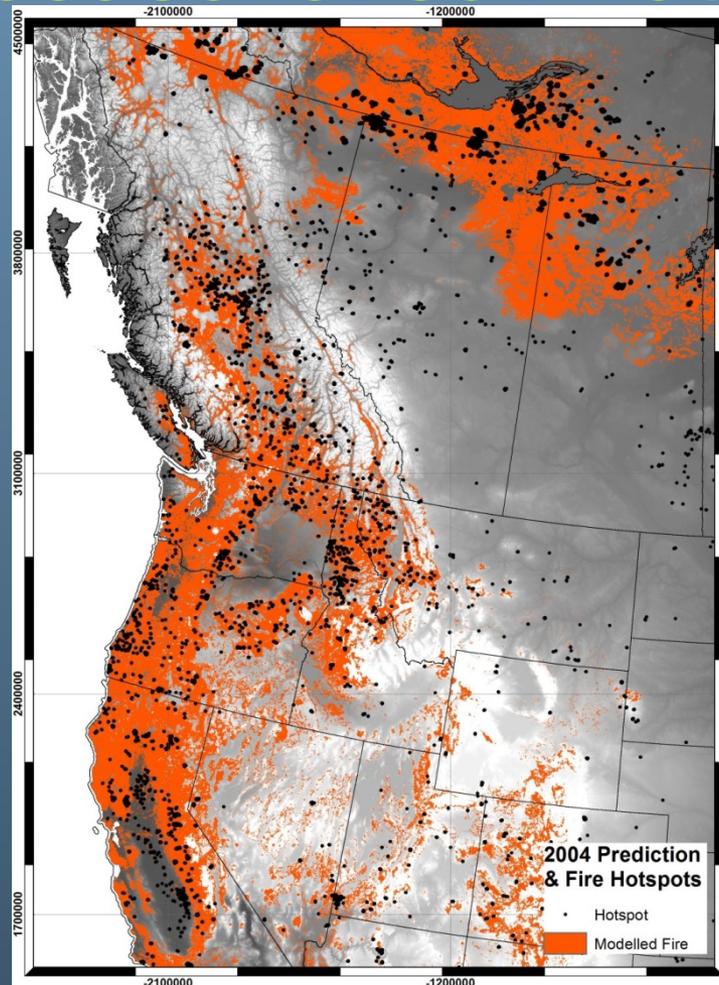
Not without much better maps of soil properties* and more accurate climatic extrapolations.

*Coops, Waring, Hilker. 2012. *Remote Sensing of Environment* 126:160-173.

Derived estimates of maximum available soil water storage

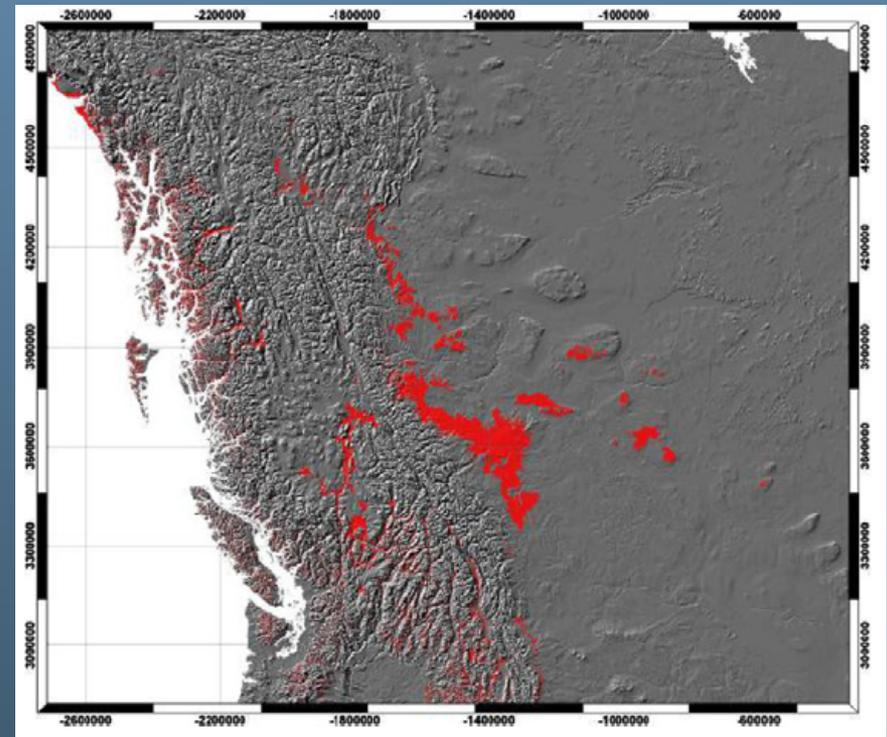
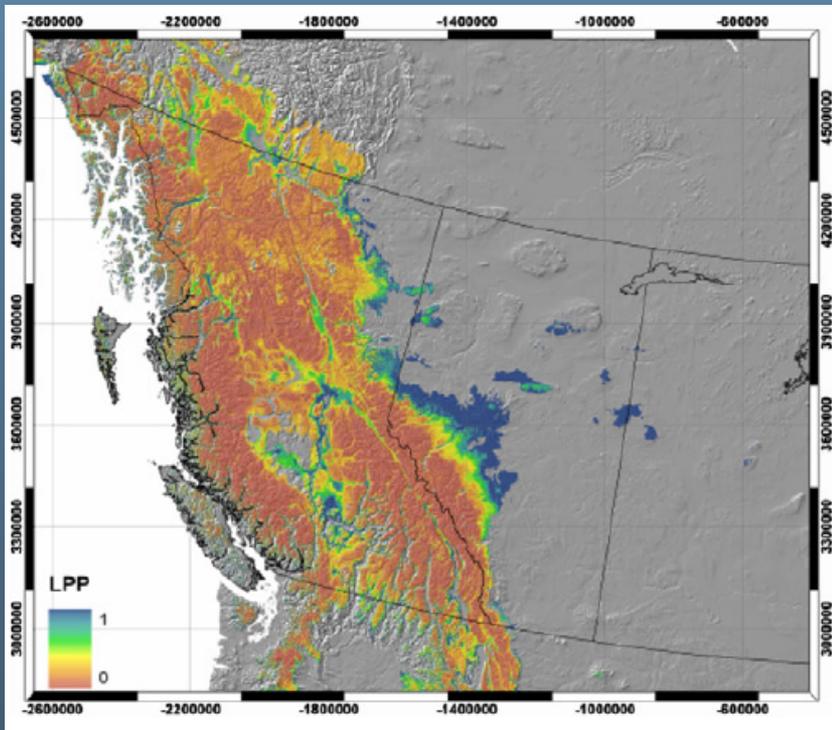


Large fires (MODIS hotspot data) predicted with 70% accuracy by modeling seasonal soil water balance



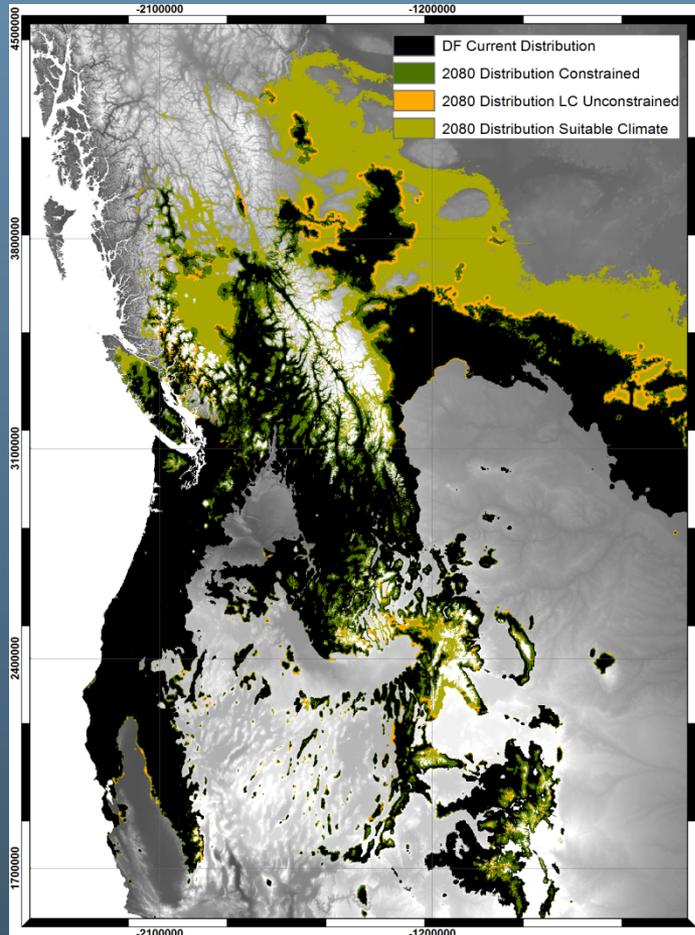
Process-based decision-tree models predict beetle outbreaks

Lodgepole pine: probability of occurrence Probability of bark beetle attack



Coops, Wulden, Waring. 2012. For. Ecol. & Management 274:161-171.

Realistic limits to migration will narrow distribution of Douglas-fir by 2080



Coops et al. 2016. Remote Sensing 8, 65; doi:10.3390/rs8010065

To Improve Predictions requires:

- Better quality data on climate and soils
- Relative age and relative density of trees
- Physiologically based models for different agents of disturbance (insects, pathogens, fire)
- Independent remotely sensed data to validate
- (MODIS multi-angle viewing of photosynthetic reflectance Index (Sousa et al., 2016, in review))